Memorandum of Understanding

between

Argonne National Laboratory
High Energy Physics Division

and

Fermi National Accelerator Laboratory

for

NOvA Experiment R&D
and Construction Work

October 11, 2007

I. Preamble

This Memorandum of Understanding is made between the Argonne National Laboratory High Energy Physics Division (Argonne) and the Fermi National Accelerator Laboratory Particle Physics Division (Fermilab). This document represents an understanding between Argonne and Fermilab in connection with NOvA detector mechanical engineering and development work. This document does not constitute a legal contractual obligation on the part of either of the parties. It reflects an arrangement that is currently satisfactory to the parties involved.

II. Responsibilities

1. Activities

The Argonne HEP Division will perform mechanical engineering and development work for the NOvA experiment. This MOU covers mechanical work for NOvA WBS 1.4 and 2.4 (PVC extrusions) and WBS 1.8, 2.8 and 2.9 (detector assembly) from October 1, 2007 until construction of the NOvA experiment is complete. The work outlined below will be performed jointly with personnel at Fermilab and other NOvA collaborating institutions.

a) PVC physical properties. Measure the modulus and creep properties of NOvA PVC materials under various conditions.
b) PVC extrusions. Produce and evaluate prototype NOvA PVC extrusions and manage the production extrusion work.
c) PVC shipping, handling and QA hardware. Develop PVC shipping, handling and quality assurance procedures. Design and build equipment for PVC quality assurance measurements.
d) Integration Prototype Near Detector (IPND). Set up the IPND block assembly facility, build four IPND blocks and install them at Fermilab.
e) Near Detector (ND). Use the facility and tooling in a) to fabricate two ND blocks and install them at Fermilab.
f) Far detector tooling design. Complete designs of tooling for assembling the far detector.
g) Full-scale block-assembly prototype (FSAP). Prepare the FSAP facility. Use it to optimize block assembly techniques and perform time and motion studies.
h) Full-height structural-engineering prototype (FHEP). Prepare the FHEP block assembly facility. Build the two FHEP blocks, install these blocks at Fermilab and measure their mechanical characteristics.
i) Management. Provide engineering and physicist effort to manage WBS Level 2 and 3 tasks for WBS 1.4, 2.4 and 1.8, 2.8 and 2.9

2. Personnel

The contact person for NOvA detector assembly activities at Argonne is David Ayres. The contact person for NOvA PVC extrusion activities at Argonne is Rich Talaga. The engineering and development work will be carried out by members of the Argonne HEP Division Mechanical Support Group under the direct supervision of the task manager, Vic Guarino.

3. Payment Authorization

The appropriate Cost Account Manager will notify Argonne when funds have been approved for specific tasks covered by this MOU. This notification will usually consist of a Fermilab

purchase order. Argonne will not commit resources to NOvA tasks covered by this MOU until such notification has been received.

4. Deliverables

Argonne will develop tooling, fabrication and procedures for producing PVC extrusions for NOvA prototypes and detectors, and for building NOvA detector components. Argonne will describe this work in engineering drawings, specifications and project planning documents. These documents will be controlled in a way that is understood by Argonne staff and the NOvA Project Office.

Argonne will manage the production of PVC extrusions and will prepare tooling and assembly facilities for IPND, ND, FSAP and FHEP block assembly. Argonne will assemble prototype blocks and detector blocks as required. Argonne will work with Fermilab procurement to solicit and evaluate proposals for NOvA equipment construction.

5. Institutional Contribution of Services and Equipment

1) Services
   The services of Argonne Administrative Staff will be available to the NOvA experiment to the degree required to carry out the work described in this document.
2) Facilities and Equipment
   The following Argonne facilities and equipment will be made available to the degree necessary to carry out the work described above.
   a) Bldg 366 high-bay area,
   b) Lab and workshop areas,
   c) Computers,
   d) Normal test equipment.
3) Operating Costs
   Argonne, subject to adequate funding from DOE, will support the normal research operating expenses (such as physicists' salaries, physicist travel expenses, miscellaneous supplies, administrative support, etc.) of the Argonne group working on the NOvA experiment.

6. Fermilab Resources Required

In addition to the costs listed in annual Statements of Work, Fermilab will provide funds for Argonne engineer travel and for materials and equipment purchases necessary to perform this work. Most purchases will be made through the Fermilab Procurement department but some small purchases will be made through Argonne procurement. Fermilab will provide appropriate areas for the installation and operation of the IPND, ND and FHEP.

Argonne performance of the detector assembly work described in this MOU will require a substantial commitment Fermilab effort and M&S funds, as described in the NOvA Project resource loaded schedule. This includes management, mechanical engineering and technical effort from the Particle Physics Division and the data acquisition and database work being performed by the Computing Division.

7. Resources Required from Other Institutions

The successful completion of the Argonne tasks covered by this MOU depends upon many contributions to this work by institutions other than Argonne and Fermilab. These include

a) University of Minnesota: far detector site civil construction, operation and maintenance; far detector assembly crew effort; detector module fabrication.
b) Caltech, Harvard, Indiana, Virginia: production and installation of photodetectors, readout electronics and associated infrastructure for the IPND, near and far detectors.
c) Indiana: production of liquid scintillator to fill detectors; liquid scintillator handling, distribution and filling systems.
d) NOvA Collaboration: commissioning and operation of the IPND, near and far detectors requires substantial effort by collaboration physicists, postdocs and graduate students.

III. Reporting, Costs and Schedule

1. Reporting

Argonne will document as NOvA notes the procedures, analyses and results obtained as this work progresses. Argonne will provide material for NOvA Project monthly reports in a timely fashion, including descriptive material, financial reporting, monthly task status reports and information needed for earned value management analysis.

2. Estimated Costs and Schedule

Argonne and Fermilab will jointly develop annual Statements of Work to provide detailed descriptions of the work covered by this MOU, including cost and schedule estimates. Argonne will monitor the progress of this work in order to provide ample notice of projected deviations from the cost and schedule estimates. If it is determined that additional funds will be needed, the Fermilab NOvA Project Manager will evaluate available options and, in consultation with Argonne, determine the best means of supplying the required resources.

IV. Other Considerations

1. Safety and Engineering Practices

All detector components will be constructed in conformity with Argonne safety policies and practices, Argonne engineering standards and Argonne ES&H policies and practices. Equipment and operating procedures provided by Argonne will conform to the NOvA Project ES&H and Integrated Safety Management policies and practices. Argonne equipment used at Fermilab or Ash River will conform to all Fermilab safety policies and practices.

2. Equipment Ownership

All items purchased or fabricated wholly with funds supplied by Fermilab will remain the property of Fermilab. Such items will be properly identified with Fermilab property tags as required by Fermilab policy. All items owned by Argonne will be identified by Argonne property tags as required by Argonne policy.

IV. Approvals

The following concur in the terms of this Memorandum of Understanding.
These terms will be updated as appropriate in Amendments to this document.

Institutional Approvals

10/12/07

D. Ayres - NOvA Group Leader, HEP Division, Argonne National Laboratory - date

10/12/07

H. Weerts - HEP Division Director, Argonne National Laboratory - date

10/16/07

J. Cooper – NOvA Project Manager, Fermilab - date

10/19/07

J. Strait – Particle Physics Division Head, Fermilab - date

10/22/07

H. Montgomery – Associate Director for Research, Fermilab - date